

## IMAGE TAKING APPARATUS, IMAGE TAKING METHOD AND CAMERA

This application claims priority to Japanese Patent Applications Nos. 2000-105267 and 2000-105270 each filed on April 6, 2000, the disclosure of which is incorporated by reference in its entirety.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to an image taking apparatus, an image taking method and a camera, which can be applied to a digital camera and the like.

#### 2. Description of Related Art

Conventionally, for example, a digital camera, which can take an image in a mode called a multiplex image taking mode for a multiplex image processing, is known.

Such a multiplex image processing is a processing for composing a plurality of images of the same photographic object taken in different photographic conditions into a single image. The multiplex image processing includes, for example, high-resolution processing for creating a high-resolution image from a plurality of images, depth control processing for adjusting depth of field by composing a plurality of images, large tone processing for extending a dynamic range for taking

an image and image stabilize processing for creating an image with no blur caused by camera movement by composing a plurality of images. The multiplex image processing is carried out by a digital camera or an external personal computer and the like.

5 The aforementioned multiplex image taking mode is a mode for obtaining a plurality of images subjected to the aforementioned multiplex image processing.

In the aforementioned multiplex image taking mode, it is a premise to take a plurality of images of the same photographic object from nearly the same image taking position. Therefore, in the multiplex image taking mode, a plurality of images of the aforementioned same photographic object are taken in sequence. Specifically, a plurality of images are sequentially taken upon a single image taking instruction by a user.

By the way, a user sometimes takes an image of a photographic object without checking the current mode. For example, in a state that the present mode is set to a multiplex image taking mode, if a user sends an image taking instruction to the digital camera, misunderstanding that the current mode is set to a single image taking mode, the user may move the digital camera when images are being taken. However, if the digital camera is moved when multiplex images are being taken, images taken at different image taking positions greatly shifted each other will be subjected to multiplex image processing. As a result, a good final composite image cannot be obtained. Furthermore, if an obstacle suddenly appears in front of the digital camera when a plurality of images are being taken, some

of the images including the image of the obstacle will also be subjected to multiplex image processing. As a result, a good final composite image cannot be obtained. The possibility of making the aforementioned mistake becomes high especially when the same image taking instruction member is shared in both the single image taking mode and the multiplex image taking mode.

Furthermore, at the stage of the multiplex image processing after having taken the multiplex images, when some images among a plurality of images taken are under-exposure, blackish portions in which shadow gradation is lost may occur in a composite image. On the contrary, when unexpectedly strong light is irradiated to the photographic object, whitish portions in which highlight gradation is lost may occur in a composite image. When an image including such blackish portions or whitish portions is subjected to multiplex image processing, the quality of the final composite image deteriorates in appearance. Thus, such an image including blackish portions or whitish portions is inappropriate for multiplex image processing.

#### SUMMARY OF THE INVENTION

It is an object of the present invention to provide an image taking apparatus which can prevent a generation of an unsuitable final composite image when abnormality disturbing multiplex image processing arises in a multiplex image taking mode.

It is another object of the present invention to provide an image taking method which can prevent a generation of an

unsuitable final composite image when abnormality disturbing multiplex image processing arises in a multiplex image taking mode.

It is still another object of the present invention to provide an image taking apparatus which can notify a user that abnormality disturbing multiplex image processing arises when the abnormality arises in a multiplex image taking mode.

It is still yet another object of the present invention to provide an image taking apparatus which can prevent an unfavorable movement of the image taking apparatus when images are being taken in a multiplex image taking mode.

It is still yet another object of the present invention to provide a camera which can prevent a generation of an unsuitable final composite image when abnormality disturbing multiplex image processing arises in a multiplex image taking mode.

It is still yet another object of the present invention to provide a camera which can notify a user that abnormality disturbing multiplex image processing arises when the abnormality arises in a multiplex image taking mode.

It is still yet another object of the present invention to provide a camera which can notify a user that images are being taken in a multiplex image taking mode.

According to a first aspect of the present invention, an image taking apparatus has a multiplex image taking mode for taking a plurality of images to be subjected to multiplex image processing by which a plurality of images are composed into a single image. The image taking apparatus includes a detector

which detects abnormality disturbing the multiplex image processing when the plurality of images are being taken in the multiplex image taking mode, and a controller which suspends processing in the multiplex image taking mode when the abnormality is detected by the detector.

With this image taking apparatus, when abnormality is detected when images are being taken, e.g., when the apparatus moves slightly or exposure becomes inappropriate when images are being taken, when an obstacle crossed in front of the image taking lens, or when the power source went dead, processing in the multiplex image taking mode is suspended. As a result, a poor image corresponding to the abnormality is prevented from being automatically subjected to the multiplex image processing. This prevents a generation of inappropriate final composite image.

According to a second aspect of the present invention, an image taking apparatus has a multiplex image taking mode for taking a plurality of images to be subjected to multiplex image processing by which a plurality of images are composed into a single image. The image taking apparatus includes a detector which detects whether or not abnormality disturbing the multiplex image processing resides in images taken in the multiplex image taking mode and a controller which suspends processing in the multiplex image taking mode when the abnormality is detected by the detector.

With this image taking apparatus, when there is an image including abnormality, e.g., an image including blackish portions

or whitish portions in which shadow gradation or highlight gradation is lost, the processing in the multiplex image taking mode is suspended. As a result, the image including such blackish portions or whitish portions is prevented from being automatically subjected to the multiplex image processing. This prevents a generation of inappropriate final composite image.

According to a third aspect of the present invention, an image taking apparatus has a multiplex image taking mode for taking a plurality of images to be subjected to multiplex image processing by which a plurality of images are composed into a single image. The image taking apparatus includes a detector which detects abnormality disturbing the multiplex image processing when images are being taken in the multiplex image taking mode and a display which indicates that a multiplex image taking is unsuccessful when the abnormality is detected by the detector.

With this image taking apparatus, a user can recognize by the display that the multiplex image taking is unsuccessful.

According to the fourth aspect of the present invention, an image taking apparatus has a multiplex image taking mode for taking a plurality of images to be subjected to multiplex image processing by which a plurality of images are composed into a single image. The image taking apparatus includes a detector which detects whether or not abnormality disturbing the multiplex image processing resides in the images taken in the multiplex image taking mode and a display which indicates that a multiplex image taking is unsuccessful when the abnormality is detected by

the detector.

With this image taking apparatus, a user can recognize by the display that abnormality arose.

According to the fifth aspect of the present invention, an image taking method comprises: detecting abnormality disturbing multiplex image processing when multiplex images are being taken, wherein the multiplex images are subjected to the multiplex image processing to be composed into a single image; and suspending processing in the multiplex image taking mode when the abnormality is detected.

With this image taking method, when abnormality is detected when images are being taken, the processing in the multiplex image processing mode is suspended. As a result, the inappropriate image corresponding to the abnormality is prevented from being automatically subjected to the multiplex image processing. This prevents a generation of inappropriate final composite image.

According to the sixth aspect of the present invention, an image taking method comprises: detecting abnormality residing in a plurality of images taken by a multiplex image taking, wherein the abnormality disturbs multiplex image processing of the plurality of images by which the plurality of images are composed into a single image; and suspending processing in the multiplex image taking mode when the abnormality is detected.

With this image taking method, when abnormality is detected in the obtained image, the processing in the multiplex image taking mode is suspended. As a result, an inappropriate image

corresponding to the abnormality is prevented from being automatically subjected to the multiplex image processing. This prevents a generation of inappropriate final composite image.

According to the seventh aspect of the present invention,  
5 an image taking apparatus has a multiplex image taking mode for taking a plurality of images to be subjected to multiplex image processing by which a plurality of images are composed into a single image. The image taking apparatus includes a display which indicates that images are being taken in the multiplex image taking mode.

With this image taking apparatus, since the display indicates that images are being taken in the multiplex image taking mode, a user can correctly recognize that the current image taking mode is a multiplex image taking mode through the  
10  
15  
20  
25  
30  
35  
40  
45  
50  
55  
60  
65  
70  
75  
80  
85  
90  
95  
100  
105  
110  
115  
120  
125  
130  
135  
140  
145  
150  
155  
160  
165  
170  
175  
180  
185  
190  
195  
200  
205  
210  
215  
220  
225  
230  
235  
240  
245  
250  
255  
260  
265  
270  
275  
280  
285  
290  
295  
300  
305  
310  
315  
320  
325  
330  
335  
340  
345  
350  
355  
360  
365  
370  
375  
380  
385  
390  
395  
400  
405  
410  
415  
420  
425  
430  
435  
440  
445  
450  
455  
460  
465  
470  
475  
480  
485  
490  
495  
500  
505  
510  
515  
520  
525  
530  
535  
540  
545  
550  
555  
560  
565  
570  
575  
580  
585  
590  
595  
600  
605  
610  
615  
620  
625  
630  
635  
640  
645  
650  
655  
660  
665  
670  
675  
680  
685  
690  
695  
700  
705  
710  
715  
720  
725  
730  
735  
740  
745  
750  
755  
760  
765  
770  
775  
780  
785  
790  
795  
800  
805  
810  
815  
820  
825  
830  
835  
840  
845  
850  
855  
860  
865  
870  
875  
880  
885  
890  
895  
900  
905  
910  
915  
920  
925  
930  
935  
940  
945  
950  
955  
960  
965  
970  
975  
980  
985  
990  
995  
1000  
1005  
1010  
1015  
1020  
1025  
1030  
1035  
1040  
1045  
1050  
1055  
1060  
1065  
1070  
1075  
1080  
1085  
1090  
1095  
1100  
1105  
1110  
1115  
1120  
1125  
1130  
1135  
1140  
1145  
1150  
1155  
1160  
1165  
1170  
1175  
1180  
1185  
1190  
1195  
1200  
1205  
1210  
1215  
1220  
1225  
1230  
1235  
1240  
1245  
1250  
1255  
1260  
1265  
1270  
1275  
1280  
1285  
1290  
1295  
1300  
1305  
1310  
1315  
1320  
1325  
1330  
1335  
1340  
1345  
1350  
1355  
1360  
1365  
1370  
1375  
1380  
1385  
1390  
1395  
1400  
1405  
1410  
1415  
1420  
1425  
1430  
1435  
1440  
1445  
1450  
1455  
1460  
1465  
1470  
1475  
1480  
1485  
1490  
1495  
1500  
1505  
1510  
1515  
1520  
1525  
1530  
1535  
1540  
1545  
1550  
1555  
1560  
1565  
1570  
1575  
1580  
1585  
1590  
1595  
1600  
1605  
1610  
1615  
1620  
1625  
1630  
1635  
1640  
1645  
1650  
1655  
1660  
1665  
1670  
1675  
1680  
1685  
1690  
1695  
1700  
1705  
1710  
1715  
1720  
1725  
1730  
1735  
1740  
1745  
1750  
1755  
1760  
1765  
1770  
1775  
1780  
1785  
1790  
1795  
1800  
1805  
1810  
1815  
1820  
1825  
1830  
1835  
1840  
1845  
1850  
1855  
1860  
1865  
1870  
1875  
1880  
1885  
1890  
1895  
1900  
1905  
1910  
1915  
1920  
1925  
1930  
1935  
1940  
1945  
1950  
1955  
1960  
1965  
1970  
1975  
1980  
1985  
1990  
1995  
2000  
2005  
2010  
2015  
2020  
2025  
2030  
2035  
2040  
2045  
2050  
2055  
2060  
2065  
2070  
2075  
2080  
2085  
2090  
2095  
2100  
2105  
2110  
2115  
2120  
2125  
2130  
2135  
2140  
2145  
2150  
2155  
2160  
2165  
2170  
2175  
2180  
2185  
2190  
2195  
2200  
2205  
2210  
2215  
2220  
2225  
2230  
2235  
2240  
2245  
2250  
2255  
2260  
2265  
2270  
2275  
2280  
2285  
2290  
2295  
2300  
2305  
2310  
2315  
2320  
2325  
2330  
2335  
2340  
2345  
2350  
2355  
2360  
2365  
2370  
2375  
2380  
2385  
2390  
2395  
2400  
2405  
2410  
2415  
2420  
2425  
2430  
2435  
2440  
2445  
2450  
2455  
2460  
2465  
2470  
2475  
2480  
2485  
2490  
2495  
2500  
2505  
2510  
2515  
2520  
2525  
2530  
2535  
2540  
2545  
2550  
2555  
2560  
2565  
2570  
2575  
2580  
2585  
2590  
2595  
2600  
2605  
2610  
2615  
2620  
2625  
2630  
2635  
2640  
2645  
2650  
2655  
2660  
2665  
2670  
2675  
2680  
2685  
2690  
2695  
2700  
2705  
2710  
2715  
2720  
2725  
2730  
2735  
2740  
2745  
2750  
2755  
2760  
2765  
2770  
2775  
2780  
2785  
2790  
2795  
2800  
2805  
2810  
2815  
2820  
2825  
2830  
2835  
2840  
2845  
2850  
2855  
2860  
2865  
2870  
2875  
2880  
2885  
2890  
2895  
2900  
2905  
2910  
2915  
2920  
2925  
2930  
2935  
2940  
2945  
2950  
2955  
2960  
2965  
2970  
2975  
2980  
2985  
2990  
2995  
3000  
3005  
3010  
3015  
3020  
3025  
3030  
3035  
3040  
3045  
3050  
3055  
3060  
3065  
3070  
3075  
3080  
3085  
3090  
3095  
3100  
3105  
3110  
3115  
3120  
3125  
3130  
3135  
3140  
3145  
3150  
3155  
3160  
3165  
3170  
3175  
3180  
3185  
3190  
3195  
3200  
3205  
3210  
3215  
3220  
3225  
3230  
3235  
3240  
3245  
3250  
3255  
3260  
3265  
3270  
3275  
3280  
3285  
3290  
3295  
3300  
3305  
3310  
3315  
3320  
3325  
3330  
3335  
3340  
3345  
3350  
3355  
3360  
3365  
3370  
3375  
3380  
3385  
3390  
3395  
3400  
3405  
3410  
3415  
3420  
3425  
3430  
3435  
3440  
3445  
3450  
3455  
3460  
3465  
3470  
3475  
3480  
3485  
3490  
3495  
3500  
3505  
3510  
3515  
3520  
3525  
3530  
3535  
3540  
3545  
3550  
3555  
3560  
3565  
3570  
3575  
3580  
3585  
3590  
3595  
3600  
3605  
3610  
3615  
3620  
3625  
3630  
3635  
3640  
3645  
3650  
3655  
3660  
3665  
3670  
3675  
3680  
3685  
3690  
3695  
3700  
3705  
3710  
3715  
3720  
3725  
3730  
3735  
3740  
3745  
3750  
3755  
3760  
3765  
3770  
3775  
3780  
3785  
3790  
3795  
3800  
3805  
3810  
3815  
3820  
3825  
3830  
3835  
3840  
3845  
3850  
3855  
3860  
3865  
3870  
3875  
3880  
3885  
3890  
3895  
3900  
3905  
3910  
3915  
3920  
3925  
3930  
3935  
3940  
3945  
3950  
3955  
3960  
3965  
3970  
3975  
3980  
3985  
3990  
3995  
4000  
4005  
4010  
4015  
4020  
4025  
4030  
4035  
4040  
4045  
4050  
4055  
4060  
4065  
4070  
4075  
4080  
4085  
4090  
4095  
4100  
4105  
4110  
4115  
4120  
4125  
4130  
4135  
4140  
4145  
4150  
4155  
4160  
4165  
4170  
4175  
4180  
4185  
4190  
4195  
4200  
4205  
4210  
4215  
4220  
4225  
4230  
4235  
4240  
4245  
4250  
4255  
4260  
4265  
4270  
4275  
4280  
4285  
4290  
4295  
4300  
4305  
4310  
4315  
4320  
4325  
4330  
4335  
4340  
4345  
4350  
4355  
4360  
4365  
4370  
4375  
4380  
4385  
4390  
4395  
4400  
4405  
4410  
4415  
4420  
4425  
4430  
4435  
4440  
4445  
4450  
4455  
4460  
4465  
4470  
4475  
4480  
4485  
4490  
4495  
4500  
4505  
4510  
4515  
4520  
4525  
4530  
4535  
4540  
4545  
4550  
4555  
4560  
4565  
4570  
4575  
4580  
4585  
4590  
4595  
4600  
4605  
4610  
4615  
4620  
4625  
4630  
4635  
4640  
4645  
4650  
4655  
4660  
4665  
4670  
4675  
4680  
4685  
4690  
4695  
4700  
4705  
4710  
4715  
4720  
4725  
4730  
4735  
4740  
4745  
4750  
4755  
4760  
4765  
4770  
4775  
4780  
4785  
4790  
4795  
4800  
4805  
4810  
4815  
4820  
4825  
4830  
4835  
4840  
4845  
4850  
4855  
4860  
4865  
4870  
4875  
4880  
4885  
4890  
4895  
4900  
4905  
4910  
4915  
4920  
4925  
4930  
4935  
4940  
4945  
4950  
4955  
4960  
4965  
4970  
4975  
4980  
4985  
4990  
4995  
5000  
5005  
5010  
5015  
5020  
5025  
5030  
5035  
5040  
5045  
5050  
5055  
5060  
5065  
5070  
5075  
5080  
5085  
5090  
5095  
5100  
5105  
5110  
5115  
5120  
5125  
5130  
5135  
5140  
5145  
5150  
5155  
5160  
5165  
5170  
5175  
5180  
5185  
5190  
5195  
5200  
5205  
5210  
5215  
5220  
5225  
5230  
5235  
5240  
5245  
5250  
5255  
5260  
5265  
5270  
5275  
5280  
5285  
5290  
5295  
5300  
5305  
5310  
5315  
5320  
5325  
5330  
5335  
5340  
5345  
5350  
5355  
5360  
5365  
5370  
5375  
5380  
5385  
5390  
5395  
5400  
5405  
5410  
5415  
5420  
5425  
5430  
5435  
5440  
5445  
5450  
5455  
5460  
5465  
5470  
5475  
5480  
5485  
5490  
5495  
5500  
5505  
5510  
5515  
5520  
5525  
5530  
5535  
5540  
5545  
5550  
5555  
5560  
5565  
5570  
5575  
5580  
5585  
5590  
5595  
5600  
5605  
5610  
5615  
5620  
5625  
5630  
5635  
5640  
5645  
5650  
5655  
5660  
5665  
5670  
5675  
5680  
5685  
5690  
5695  
5700  
5705  
5710  
5715  
5720  
5725  
5730  
5735  
5740  
5745  
5750  
5755  
5760  
5765  
5770  
5775  
5780  
5785  
5790  
5795  
5800  
5805  
5810  
5815  
5820  
5825  
5830  
5835  
5840  
5845  
5850  
5855  
5860  
5865  
5870  
5875  
5880  
5885  
5890  
5895  
5900  
5905  
5910  
5915  
5920  
5925  
5930  
5935  
5940  
5945  
5950  
5955  
5960  
5965  
5970  
5975  
5980  
5985  
5990  
5995  
6000  
6005  
6010  
6015  
6020  
6025  
6030  
6035  
6040  
6045  
6050  
6055  
6060  
6065  
6070  
6075  
6080  
6085  
6090  
6095  
6100  
6105  
6110  
6115  
6120  
6125  
6130  
6135  
6140  
6145  
6150  
6155  
6160  
6165  
6170  
6175  
6180  
6185  
6190  
6195  
6200  
6205  
6210  
6215  
6220  
6225  
6230  
6235  
6240  
6245  
6250  
6255  
6260  
6265  
6270  
6275  
6280  
6285  
6290  
6295  
6300  
6305  
6310  
6315  
6320  
6325  
6330  
6335  
6340  
6345  
6350  
6355  
6360  
6365  
6370  
6375  
6380  
6385  
6390  
6395  
6400  
6405  
6410  
6415  
6420  
6425  
6430  
6435  
6440  
6445  
6450  
6455  
6460  
6465  
6470  
6475  
6480  
6485  
6490  
6495  
6500  
6505  
6510  
6515  
6520  
6525  
6530  
6535  
6540  
6545  
6550  
6555  
6560  
6565  
6570  
6575  
6580  
6585  
6590  
6595  
6600  
6605  
6610  
6615  
6620  
6625  
6630  
6635  
6640  
6645  
6650  
6655  
6660  
6665  
6670  
6675  
6680  
6685  
6690  
6695  
6700  
6705  
6710  
6715  
6720  
6725  
6730  
6735  
6740  
6745  
6750  
6755  
6760  
6765  
6770  
6775  
6780  
6785  
6790  
6795  
6800  
6805  
6810  
6815  
6820  
6825  
6830  
6835  
6840  
6845  
6850  
6855  
6860  
6865  
6870  
6875  
6880  
6885  
6890  
6895  
6900  
6905  
6910  
6915  
6920  
6925  
6930  
6935  
6940  
6945  
6950  
6955  
6960  
6965  
6970  
6975  
6980  
6985  
6990  
6995  
7000  
7005  
7010  
7015  
7020  
7025  
7030  
7035  
7040  
7045  
7050  
7055  
7060  
7065  
7070  
7075  
7080  
7085  
7090  
7095  
7100  
7105  
7110  
7115  
7120  
7125  
7130  
7135  
7140  
7145  
7150  
7155  
7160  
7165  
7170  
7175  
7180  
7185  
7190  
7195  
7200  
7205  
7210  
7215  
7220  
7225  
7230  
7235  
7240  
7245  
7250  
7255  
7260  
7265  
7270  
7275  
7280  
7285  
7290  
7295  
7300  
7305  
7310  
7315  
7320  
7325  
7330  
7335  
7340  
7345  
7350  
7355  
7360  
7365  
7370  
7375  
7380  
7385  
7390  
7395  
7400  
7405  
7410  
7415  
7420  
7425  
7430  
7435  
7440  
7445  
7450  
7455  
7460  
7465  
7470  
7475  
7480  
7485  
7490  
7495  
7500  
7505  
7510  
7515  
7520  
7525  
7530  
7535  
7540  
7545  
7550  
7555  
7560  
7565  
7570  
7575  
7580  
7585  
7590  
7595  
7600  
7605  
7610  
7615  
7620  
7625  
7630  
7635  
7640  
7645  
7650  
7655  
7660  
7665  
7670  
7675  
7680  
7685  
7690  
7695  
7700  
7705  
7710  
7715  
7720  
7725  
7730  
7735  
7740  
7745  
7750  
7755  
7760  
7765  
7770  
7775  
7780  
7785  
7790  
7795  
7800  
7805  
7810  
7815  
7820  
7825  
7830  
7835  
7840  
7845  
7850  
7855  
7860  
7865  
7870  
7875  
7880  
7885  
7890  
7895  
7900  
7905  
7910  
7915  
7920  
7925  
7930  
7935  
7940  
7945  
7950  
7955  
7960  
7965  
7970  
7975  
7980  
7985  
7990  
7995  
8000  
8005  
8010  
8015  
8020  
8025  
8030  
8035  
8040  
8045  
8050  
8055  
8060  
8065  
8070  
8075  
8080  
8085  
8090  
8095  
8100  
8105  
8110  
8115  
8120  
8125  
8130  
8135  
8140  
8145  
8150  
8155  
8160  
8165  
8170  
8175  
8180  
8185  
8190  
8195  
8200  
8205  
8210  
8215  
8220  
8225  
8230  
8235  
8240  
8245  
8250  
8255  
8260  
8265  
8270  
8275  
8280  
8285  
8290  
8295  
8300  
8305  
8310  
8315  
8320  
8325  
8330  
8335  
8340  
8345  
8350  
8355  
8360  
8365  
8370  
8375  
8380  
8385  
8390  
8395  
8400  
8405  
8410  
8415  
8420  
8425  
8430  
8435  
8440  
8445  
8450  
8455  
8460  
8465  
8470  
8475  
8480  
8485  
8490  
8495  
8500  
8505  
8510  
8515  
8520  
8525  
8530  
8535  
8540  
8545  
8550  
8555  
8560  
8565  
8570  
8575  
8580  
8585  
8590  
8595  
8600  
8605  
8610  
8615  
8620  
8625  
8630  
8635  
8640  
8645  
8650  
8655  
8660  
8665  
8670  
8675  
8680  
8685  
8690  
8695  
8700  
8705  
8710  
8715  
8720  
8725  
8730  
8735  
8740  
8745  
8750  
8755  
8760  
8765  
8770  
8775  
8780  
8785  
8790  
8795  
8800  
8805  
8810  
8815  
8820  
8825  
8830  
8835  
8840  
8845  
8850  
8855  
8860  
8865  
8870  
8875  
8880  
8885  
8890  
8895  
8900  
8905  
8910  
8915  
8920  
8925  
8930  
8935  
8940  
8945  
8950  
8955  
8960  
8965  
8970  
8975  
8980  
8985  
8990  
8995  
9000  
9005  
9010  
9015  
9020  
9025  
9030  
9035  
9040  
9045  
9050  
9055  
9060  
9065  
9070  
9075  
9080  
9085  
9090  
9095  
9100  
9105  
9110  
9115  
9120  
9125  
9130  
9135  
9140  
9145  
9150  
9155  
9160  
9165  
9170  
9175  
9180  
9185  
9190  
9195  
9200  
9205  
9210  
9215  
9220  
9225  
9230  
9235  
9240  
9245  
9250  
9255  
9260  
9265  
9270  
9275  
9280  
9285  
9290  
9295  
9300  
9305  
9310  
9315  
9320  
9325  
9330  
9335  
9340  
9345  
9350  
9355  
9360  
9365  
9370  
9375  
9380  
9385  
9390  
9395  
9400  
9405  
9410  
9415  
9420  
9425  
9430  
9435  
9440  
9445  
9450  
9455  
9460  
9465  
9470  
9475  
9480  
9485  
9490  
9495  
9500  
9505  
9510  
9515  
9520  
9525  
9530  
9535  
9540  
9545  
9550  
9555  
9560  
9565  
9570  
9575  
9580  
9585  
9590  
9595  
9600  
9605  
9610  
9615  
9620  
9625  
9630  
9635  
9640  
9645  
9650  
9655  
9660  
9665  
9670  
9675  
9680  
9685  
9690  
9695  
9700  
9705  
9710  
9715  
9720  
9725  
9730  
9735  
9740  
9745  
9750  
9755  
9760  
9765  
9770  
9775  
9780  
9785  
9790  
9795  
9800  
9805  
9810  
9815  
9820  
9825  
9830  
9835  
9840  
9845  
9850  
9855  
9860  
9865  
9870  
9875  
9880  
9885  
9890  
9895  
9900  
9905  
9910  
9915  
9920  
9925  
9930  
9935  
9940  
9945  
9950  
9955  
9960  
9965  
9970  
9975  
9980  
9985  
9990  
9995  
10000  
10005  
10010  
10015  
10020  
10025  
10030  
10035  
10040  
10045  
10050  
10055  
10060  
10065  
10070  
10075  
10080  
10085  
10090  
10095  
10100  
10105  
10110  
10115  
10120  
10125  
10130  
10135  
10140  
10145  
10150  
10155  
10160  
10165  
10170  
10175  
10180  
10185  
10190  
10195  
10200  
10205  
10210  
10215  
10220  
10225  
10230  
10235  
10240  
10245  
10250  
10255  
10260  
1



taking a plurality of images to be composed into a single image among a plurality of image taking modes, a detector for detecting whether or not there is abnormality disturbing the composing when the plurality of images are being taken in the specific mode, and a controller which suspends processing in the specific mode when the abnormality is detected by the detector.

With this camera, when abnormality is detected when images are being taken, the processing in the multiplex image taking mode is suspended. As a result, it is prevented an inappropriate final composite image from being generated by automatically continuing the processing in the multiplex image taking mode.

According to the tenth aspect of the present invention, a camera includes a selector which selects a specific mode for taking a plurality of images to be composed into a single image among a plurality of image taking modes, a detector which detects whether or not abnormality disturbing the composing resides in the plurality of images taken in the specific mode, and a controller which suspends processing in the specific mode when the abnormality is detected by the detector.

With this camera, when there is an abnormal image, the processing in the multiplex image taking mode is suspended. Thus, it is prevented an inappropriate final composite image from being generated.

According to the eleventh aspect of the present invention, a camera includes a selector which selects a specific mode for taking a plurality of image to be composed into a single image among a plurality of image taking modes, a detector for detecting

whether or not there is abnormality disturbing the composing when the plurality of images are being taken in the specific mode and a display which indicates that the image taking in the specific mode is unsuccessful when the abnormality is detected by the detector.

With this camera, a user can recognize by the display that the multiplex image taking is unsuccessful.

According to the twelfth aspect of the present invention, a camera includes a selector which selects a specific mode for taking a plurality of images to be composed into a single image among a plurality of image taking modes, a detector which detects whether or not abnormality disturbing the composing resides in the plurality of images taken in the specific mode, and a display which indicates that the image taking in the specific mode is unsuccessful when the abnormality is detected by the detector.

With this camera, a user can recognize by the display that abnormality arose.

Other objects and the features will be apparent from the following detailed description of the invention with reference to the attached drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully described and better understood from the following description, taken with the appended drawings, in which:

Fig. 1 is a front view showing a digital camera which is an

embodiment of the present invention is applied;

Fig. 2 is a rear view showing the digital camera;

Fig. 3 is a bottom view showing the digital camera;

Fig. 4 is a block diagram showing a control system of the  
5 digital camera;

Fig. 5 is a block diagram showing the whole control system  
shown in Fig. 4;

Fig. 6 is an explanatory view of an image memory structure  
in a memory card;

Fig. 7 is an explanatory view of a display portion provided  
in a liquid crystal display portion (view finder);

Fig. 8 is a flow chart showing an operation in a single  
image taking mode;

Fig. 9 is a flow chart showing an operation in a multiplex  
image taking mode;

Fig. 10 is an explanatory view of a selection method of a  
plurality of images;

Fig. 11 is an explanatory view of a modification of the  
display portion in a finder;

Fig. 12 is an explanatory view of another modification of  
the display portion in the finder;

Fig. 13 is a front view of the digital camera showing the  
display portion when multiplex images are being taken; and

Fig. 14 is a flow chart showing an operation in a multiplex  
25 image taking mode in another embodiment.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs. 1 to 3 show a digital camera as an image taking apparatus according to an embodiment of the present invention. In this embodiment, multiplex image processing is executed by an external apparatus such as a personal computer.

5 As shown in Figs. 1 to 3, the digital camera 1 comprises a box-shaped camera main body 2 and a rectangular parallelepiped image pick-up portion 3 which is attachable to and removable from the main body 2 on the right side thereof in the front view shown in Fig. 1. The image pick-up portion 3 is pivotable within a plane parallel to the right side of the main body 2.

10 The image pick-up portion 3 has an image taking apparatus including an image taking lens 301 comprising a zoom lens and a photoelectric conversion device such as a CCD 303 (Charge Coupled Device) shown in Fig. 4, to convert the optical image of a  
15 photographic object into an electric image consisting of charge signals, each of which was generated by each pixel of the CCD via photoelectric conversion.

20 The camera main body 2 has a display 10 or an LCD (Liquid Crystal Display), a slot 17 for receiving a memory card 8 as a recording media and a connection terminal 13 for connecting the digital camera 1 to a personal computer or the like. The image signal taken by the image pick-up portion 3 is subjected to prescribed signal processing. The processed image is displayed  
25 on the LCD 10, recorded in the memory card 8 or transferred to network connected apparatus 19 (see Fig. 4) such as a personal computer.

The image taking lens 301 is provided in the image pick-up

portion 3. An image pick-up circuit including a CCD color area sensor 303 (Fig. 4) is provided at an appropriate position behind the image taking lens 301. A light-quantity adjusting circuit 304 having a light receiving sensor 305 for receiving flash light reflected from the photographic object is provided at an appropriate position in the image pick-up portion 3.

The light receiving sensor 305 detects an amount of incident ray into the image taking lens 301, and also can detect that a person, etc. crossed in front of the image taking lens 301.

Furthermore, a white balance (WB) sensor 21, a distance sensor (not shown), etc. are provided at a proper place in the image pick-up portion 3. The WB sensor 21 detects the color temperature of light to adjust the white balance of an image. Furthermore, the distance sensor measures the distance to a photographic object for an automatic focus (AF).

As shown in Fig. 1, a grip 4 is formed in the left-hand side of the front face of the camera main body 2, and a built-in electronic flash 5 is provided in the right-hand upper side at an appropriate position. Frame forwarding and reversing switches 6 and 7 are provided near the center of the top face of the camera main body 2 as shown in Fig. 1. The forwarding switch 6 changes the displayed frame in the direction that the frame number increases in the image taking order, and is referred to as an UP key 6. The reversing switch 7 changes the displayed frame in the direction that the frame number decreases, and is referred to as a DOWN key 7. A delete key D for deleting the images recorded in the memory card 8 is provided on the left side

of the DOWN key 7, and a shutter button 9 is provided on the right side of the UP key 6 in the rear view shown in Fig. 2.

As shown in Fig. 2, an LCD 10 is provided in the middle of the left-hand side of the rear face of the camera main body 2.

5 The LCD 10 functions as a viewfinder during image taking, and as a display during the reproduction of the recorded image. Furthermore, as shown in Fig. 7, at the lower portion in the LCD 10, an indicator 431 for indicating/warning a generation of abnormality inconvenient to multiplex image processing in the multiplex image taking mode and an indicator 432 for indicating that images are being taken in the multiplex image taking mode, are provided so that a user can easily recognize the aforementioned indicators 431 and 432 when the user views the image of the photographic object VD. The turn-on/off control of the indicator 432 is performed by the general control portion 211 based on the signal of the mode setting switch 14 which will be mentioned later. Also, the turn-on/off control of the indicator 431 is performed by the general control portion 211.

10 Provided at the lower side of the LCD 10 is a compression rate setting slide switch 12 for switching the compression rate K of the image data to be recorded in the memory card 8. A power switch PS is provided on the top portion of the rear face of the camera main body 2. The connection terminal 13 is provided on the side face of the camera main body 2 near the image pick-up portion 3.

15 Furthermore, the microphone combination speaker MIC for recording sound or generating the recorded sound at the time of

reproduction is provided at the camera main body 2. When an image signal is reproduced, the voice signal included in the image signal can be heard through the microphone MIC.

5 The electronic flash (which may be abbreviated as "FL") of the digital camera 1 has an "automatic flash mode," a "forcible flash mode" and a "flash prohibition mode." In the "automatic flash mode," the built-in electronic flash 5 is automatically flashed according to the luminance of the photographic object. In the "forcible flash mode," the built-in electronic flash 5 is forcibly flashed regardless of the luminance of the photographic object. In the "flash prohibition mode," light emission of the built-in electronic flash 5 is prohibited. Every time the user depresses the FL mode setting key 11 positioned above the LCD 10 on the rear face of the camera main body 2, the flash mode is switched among three modes in a cyclic order.

10  
20  
30  
40  
50  
60  
70  
80  
90  
100  
110  
120  
130  
140  
150  
160  
170  
180  
190  
200  
210  
220  
230  
240  
250  
260  
270  
280  
290  
300  
310  
320  
330  
340  
350  
360  
370  
380  
390  
400  
410  
420  
430  
440  
450  
460  
470  
480  
490  
500  
510  
520  
530  
540  
550  
560  
570  
580  
590  
600  
610  
620  
630  
640  
650  
660  
670  
680  
690  
700  
710  
720  
730  
740  
750  
760  
770  
780  
790  
800  
810  
820  
830  
840  
850  
860  
870  
880  
890  
900  
910  
920  
930  
940  
950  
960  
970  
980  
990  
1000  
1010  
1020  
1030  
1040  
1050  
1060  
1070  
1080  
1090  
1100  
1110  
1120  
1130  
1140  
1150  
1160  
1170  
1180  
1190  
1200  
1210  
1220  
1230  
1240  
1250  
1260  
1270  
1280  
1290  
1300  
1310  
1320  
1330  
1340  
1350  
1360  
1370  
1380  
1390  
1400  
1410  
1420  
1430  
1440  
1450  
1460  
1470  
1480  
1490  
1500  
1510  
1520  
1530  
1540  
1550  
1560  
1570  
1580  
1590  
1600  
1610  
1620  
1630  
1640  
1650  
1660  
1670  
1680  
1690  
1700  
1710  
1720  
1730  
1740  
1750  
1760  
1770  
1780  
1790  
1800  
1810  
1820  
1830  
1840  
1850  
1860  
1870  
1880  
1890  
1900  
1910  
1920  
1930  
1940  
1950  
1960  
1970  
1980  
1990  
2000  
2010  
2020  
2030  
2040  
2050  
2060  
2070  
2080  
2090  
2100  
2110  
2120  
2130  
2140  
2150  
2160  
2170  
2180  
2190  
2200  
2210  
2220  
2230  
2240  
2250  
2260  
2270  
2280  
2290  
2300  
2310  
2320  
2330  
2340  
2350  
2360  
2370  
2380  
2390  
2400  
2410  
2420  
2430  
2440  
2450  
2460  
2470  
2480  
2490  
2500  
2510  
2520  
2530  
2540  
2550  
2560  
2570  
2580  
2590  
2600  
2610  
2620  
2630  
2640  
2650  
2660  
2670  
2680  
2690  
2700  
2710  
2720  
2730  
2740  
2750  
2760  
2770  
2780  
2790  
2800  
2810  
2820  
2830  
2840  
2850  
2860  
2870  
2880  
2890  
2900  
2910  
2920  
2930  
2940  
2950  
2960  
2970  
2980  
2990  
3000  
3010  
3020  
3030  
3040  
3050  
3060  
3070  
3080  
3090  
3100  
3110  
3120  
3130  
3140  
3150  
3160  
3170  
3180  
3190  
3200  
3210  
3220  
3230  
3240  
3250  
3260  
3270  
3280  
3290  
3300  
3310  
3320  
3330  
3340  
3350  
3360  
3370  
3380  
3390  
3400  
3410  
3420  
3430  
3440  
3450  
3460  
3470  
3480  
3490  
3500  
3510  
3520  
3530  
3540  
3550  
3560  
3570  
3580  
3590  
3600  
3610  
3620  
3630  
3640  
3650  
3660  
3670  
3680  
3690  
3700  
3710  
3720  
3730  
3740  
3750  
3760  
3770  
3780  
3790  
3800  
3810  
3820  
3830  
3840  
3850  
3860  
3870  
3880  
3890  
3900  
3910  
3920  
3930  
3940  
3950  
3960  
3970  
3980  
3990  
4000  
4010  
4020  
4030  
4040  
4050  
4060  
4070  
4080  
4090  
4100  
4110  
4120  
4130  
4140  
4150  
4160  
4170  
4180  
4190  
4200  
4210  
4220  
4230  
4240  
4250  
4260  
4270  
4280  
4290  
4300  
4310  
4320  
4330  
4340  
4350  
4360  
4370  
4380  
4390  
4400  
4410  
4420  
4430  
4440  
4450  
4460  
4470  
4480  
4490  
4500  
4510  
4520  
4530  
4540  
4550  
4560  
4570  
4580  
4590  
4600  
4610  
4620  
4630  
4640  
4650  
4660  
4670  
4680  
4690  
4700  
4710  
4720  
4730  
4740  
4750  
4760  
4770  
4780  
4790  
4800  
4810  
4820  
4830  
4840  
4850  
4860  
4870  
4880  
4890  
4900  
4910  
4920  
4930  
4940  
4950  
4960  
4970  
4980  
4990  
5000  
5010  
5020  
5030  
5040  
5050  
5060  
5070  
5080  
5090  
5100  
5110  
5120  
5130  
5140  
5150  
5160  
5170  
5180  
5190  
5200  
5210  
5220  
5230  
5240  
5250  
5260  
5270  
5280  
5290  
5300  
5310  
5320  
5330  
5340  
5350  
5360  
5370  
5380  
5390  
5400  
5410  
5420  
5430  
5440  
5450  
5460  
5470  
5480  
5490  
5500  
5510  
5520  
5530  
5540  
5550  
5560  
5570  
5580  
5590  
5600  
5610  
5620  
5630  
5640  
5650  
5660  
5670  
5680  
5690  
5700  
5710  
5720  
5730  
5740  
5750  
5760  
5770  
5780  
5790  
5800  
5810  
5820  
5830  
5840  
5850  
5860  
5870  
5880  
5890  
5900  
5910  
5920  
5930  
5940  
5950  
5960  
5970  
5980  
5990  
6000  
6010  
6020  
6030  
6040  
6050  
6060  
6070  
6080  
6090  
6100  
6110  
6120  
6130  
6140  
6150  
6160  
6170  
6180  
6190  
6200  
6210  
6220  
6230  
6240  
6250  
6260  
6270  
6280  
6290  
6300  
6310  
6320  
6330  
6340  
6350  
6360  
6370  
6380  
6390  
6400  
6410  
6420  
6430  
6440  
6450  
6460  
6470  
6480  
6490  
6500  
6510  
6520  
6530  
6540  
6550  
6560  
6570  
6580  
6590  
6600  
6610  
6620  
6630  
6640  
6650  
6660  
6670  
6680  
6690  
6700  
6710  
6720  
6730  
6740  
6750  
6760  
6770  
6780  
6790  
6800  
6810  
6820  
6830  
6840  
6850  
6860  
6870  
6880  
6890  
6900  
6910  
6920  
6930  
6940  
6950  
6960  
6970  
6980  
6990  
7000  
7010  
7020  
7030  
7040  
7050  
7060  
7070  
7080  
7090  
7100  
7110  
7120  
7130  
7140  
7150  
7160  
7170  
7180  
7190  
7200  
7210  
7220  
7230  
7240  
7250  
7260  
7270  
7280  
7290  
7300  
7310  
7320  
7330  
7340  
7350  
7360  
7370  
7380  
7390  
7400  
7410  
7420  
7430  
7440  
7450  
7460  
7470  
7480  
7490  
7500  
7510  
7520  
7530  
7540  
7550  
7560  
7570  
7580  
7590  
7600  
7610  
7620  
7630  
7640  
7650  
7660  
7670  
7680  
7690  
7700  
7710  
7720  
7730  
7740  
7750  
7760  
7770  
7780  
7790  
7800  
7810  
7820  
7830  
7840  
7850  
7860  
7870  
7880  
7890  
7900  
7910  
7920  
7930  
7940  
7950  
7960  
7970  
7980  
7990  
8000  
8010  
8020  
8030  
8040  
8050  
8060  
8070  
8080  
8090  
8100  
8110  
8120  
8130  
8140  
8150  
8160  
8170  
8180  
8190  
8200  
8210  
8220  
8230  
8240  
8250  
8260  
8270  
8280  
8290  
8300  
8310  
8320  
8330  
8340  
8350  
8360  
8370  
8380  
8390  
8400  
8410  
8420  
8430  
8440  
8450  
8460  
8470  
8480  
8490  
8500  
8510  
8520  
8530  
8540  
8550  
8560  
8570  
8580  
8590  
8600  
8610  
8620  
8630  
8640  
8650  
8660  
8670  
8680  
8690  
8700  
8710  
8720  
8730  
8740  
8750  
8760  
8770  
8780  
8790  
8800  
8810  
8820  
8830  
8840  
8850  
8860  
8870  
8880  
8890  
8900  
8910  
8920  
8930  
8940  
8950  
8960  
8970  
8980  
8990  
9000  
9010  
9020  
9030  
9040  
9050  
9060  
9070  
9080  
9090  
9100  
9110  
9120  
9130  
9140  
9150  
9160  
9170  
9180  
9190  
9200  
9210  
9220  
9230  
9240  
9250  
9260  
9270  
9280  
9290  
9300  
9310  
9320  
9330  
9340  
9350  
9360  
9370  
9380  
9390  
9400  
9410  
9420  
9430  
9440  
9450  
9460  
9470  
9480  
9490  
9500  
9510  
9520  
9530  
9540  
9550  
9560  
9570  
9580  
9590  
9600  
9610  
9620  
9630  
9640  
9650  
9660  
9670  
9680  
9690  
9700  
9710  
9720  
9730  
9740  
9750  
9760  
9770  
9780  
9790  
9800  
9810  
9820  
9830  
9840  
9850  
9860  
9870  
9880  
9890  
9900  
9910  
9920  
9930  
9940  
9950  
9960  
9970  
9980  
9990  
10000

20 The digital camera 1 has a 1/8 compression rate and a 1/20 compression rate, and a user can select the preferred compression rate K. For example, when the compression rate setting switch 12 is shifted to the right, the compression rate K is set to 1/8, and when it is shifted to the left, the compression rate K is set to 1/20.

25 Furthermore, at the right end upper portion of the rear surface of the camera main portion 2, a mode setting switch 14 for selecting one of a "standard image taking mode (single image taking mode)" and a "multiplex image taking mode" is provided. The aforementioned standard image taking mode is a mode for taking a single image, and the aforementioned multiplex image

taking mode is a mode for sequentially taking a plurality of images for multiplex image processing. The mode setting switch 14 is also a slide switch of two positions. When the switch is shifted to the right, the standard image taking mode will be selected, and when it is shifted to the left, the multiplex image taking mode will be selected.

A battery cavity 18 and a slot 17 for receiving a memory card 8 are provided at the bottom face of the main body 2. The battery cavity 18 and the slot 17 are covered with a clam-shell type cover 15. The digital camera 1 according to this embodiment uses a power supply source consisting of four AA batteries connected in series.

Fig. 4 is a block diagram of the control system of the digital camera 1.

In the image pick-up portion 3, the CCD 303 photoelectrically converts the optical image of the photographic object focused by the zoom lens 301 into image signals of three color components R (red), G (green) and B (blue). The image signal consists of sequence of pixel signals received by the respective pixel. The timing generator 314 generates various kinds of timing pulses for controlling the drive of the CCD 303.

Since the size of an aperture stop of the image pick-up portion 3 is fixed, the exposure control is performed by adjusting the quantity of light exposure of the CCD 303, i.e., the electric charge accumulation time of the CCD 303 corresponding to the shutter speed. When the luminance of the photographic object is too low to select to an appropriate



shutter speed, the level of the image signal outputted from the CCD 303 is adjusted in order to compensate for the insufficient exposure. In other words, at a low luminance, the exposure is controlled by adjusting both the shutter speed and the gain. The level of the image signal is adjusted by controlling the gain of the AGC circuit in the signal processor 313.

The timing generator 314 generates various driving control signals for the CCD 303 based on the reference clock supplied from the timing control circuit 202. The signals generated by the timing generator 314 includes a timing signal for starting and finishing integration (i.e., exposure), and clock signals for controlling the reading timing of the light-receiving signals (horizontal synchronization signals, vertical synchronization signals, transfer signals, etc.) from the respective pixels. These timing signals are supplied to the CCD 303.

The signal processing circuit 313 performs predetermined analog signal processing to the image signal (analog signal) outputted from the CCD 303. The signal processing circuit 313 has a CDS (correlation double sampling) circuit for reducing the noise of the image signal and an AGC (automatic gain control) circuit for adjusting the level of the image signal by controlling the gain of this AGC circuit.

The light-quantity adjusting circuit 304 sets the light emission of the built-in electronic flash 5 to a predetermined level determined by the general control portion 211 when the electronic flash is used during the image taking. During the flash image taking, the flash light reflected from the

photographic object is received by the light-adjusting sensor 305 upon starting exposure. When the quantity of light received by the sensor 305 reaches a predetermined level, the light-quantity adjusting circuit 304 supplies a flash stop signal to the flash control circuit 214 via the general control portion 211. In response to the flash stop signal, the flash control circuit 214 stops the light emission of the built-in electronic flash 5, whereby the light emission amount of the built-in electronic flash 5 can be regulated to the prescribed level.

The light-receiving sensor 305 is also used as a light-receiving element for controlling the exposure, which measures a brightness of the photographic object in a sequence image taking mode. The light-receiving sensor 305 detects the difference of the brightness with regard to the brightness at the start of the sequence image taking mode to adjust the exposure of the next frame in the sequence mode in accordance with the difference.

The A/D converter 205 provided in the camera main body 2 converts each pixel signal (i.e., analog signal) of the image signal sequence into a 10-bit digital signal based on the A/D conversion clock supplied from the A/D clock generator (not shown).

A timing control circuit 202 which generates a reference clock and a clock for a timing generator 314 and an A/D converter 205 is also provided in the camera main body 2. The timing control circuit 202 is controlled by the general control portion 211.

A black level correction circuit 206 corrects the black level of the digitalized pixel signal (hereinafter referred to as pixel data) converted by the A/D converter 205 to the reference black level. A white balance circuit (hereinafter referred to as "WB circuit") 207 converts the level of the pixel data of each color component of R, G or B, so that the white balance can be also adjusted after  $\gamma$  correction. The WB circuit 207 converts the level of the pixel data of each color component R, G, B using a level conversion table inputted from the general control portion 211. The conversion coefficient (or the slope of the characteristic line) for each color component in the level conversion table is set each taken image by the general control portion 211.

The  $\gamma$  correction circuit 208 corrects for the characteristic of the pixel data. The  $\gamma$  correction circuit 208 has, for example, six  $\gamma$  correction tables with different characteristics, and uses the most appropriate  $\gamma$  correction table according to the photographed scene or the photographic conditions.

An image memory 209 stores the pixel data outputted from the  $\gamma$  correction circuit 208. The memory capacity of the image memory 209 corresponds to M frames data. Accordingly, if the CCD 303 has an  $n \times m$  pixel matrix, the image memory 209 has a memory capacity of  $M \times n \times m$  pixel data, and each pixel data is stored in the corresponding pixel position in the memory.

A VRAM 210 is a buffer memory for storing the image data which is to be reproduced and displayed on the LCD 10. The

memory capacity of the VRAM 210 corresponds to the number of pixels of the LCD 10.

"MIC" denotes a microphone combination speaker, as mentioned above. In cases where the below-mentioned image signals are reproduced, the voice signals are separated from the image signals by the general control portion 211, and the separated voice signals can be heard through this speaker MIC.

In the image taking preparation mode, each pixel data of the image taken by the image pick-up portion 3 every 1/30 seconds is subjected to the prescribed signal processing by the sequence from the A/D converter 205 to the  $\gamma$  correction circuit 208, and stored in the image memory 209. This pixel data is simultaneously transferred to the VRAM 210 via the general control portion 211, and displayed on the LCD 10. Whereby, the user can recognize the photographic object on the LCD 10. In the reproduction mode, the image read out from the memory card 8 is subjected to the prescribed signal processing by the general control portion 211, which is then transferred to the VRAM 210, and displayed on the LCD 10.

A card I/F 212 is an interface for writing the image data into the memory card 8 or reading the image data from the memory card 8. A communication I/F 213 is an interface based on, for example, the IEEE 1394 standard, or an interface for externally connecting the personal computer 19.

A flash control circuit 214 controls light emission of the built-in electronic flash 5. In particular, the flash control circuit 214 controls the quantity of flash light, flash emission

timing, and so on, based on the control signal supplied from the general control portion 211. The flash control circuit 214 also brings the light emission to zero based on the flash stop signal STP inputted from the light-quantity adjusting circuit 304.

5        An RTC (Real Time Clock) 219 is a time circuit for keeping the track of the date and time of each image taking, which is driven by a separate power source (not shown).

10        An operation unit 250 has switches corresponding to the UP key 6, the DOWN key 7, the shutter button 9, the FL mode setting key 11, the compression rate setting key 12, and the photographing/reproduction mode setting switch 14.

15        The aforementioned WB sensor 21 and a camera-movement sensor 320 are connected to the general control portion 211. The camera-movement sensor 320 detects the movement of the digital camera 1 when a user is taking an image while holding the camera, for example, by hands, and includes a gyroscope having a position displacement detection function. Moreover, a sensor (not shown) for detecting the capacity shortage of each power supply is also connected to the general control portion 211.

20        The general control portion 211 comprises a micro computer, and it organically controls the drive of each element in the image pick-up portion 3 and the camera main body 2 so as to generally control the image taking operation of the digital camera 1.

25        Furthermore, in a state where the mode setting switch 14 is set to the multiplex image taking mode, the general control portion 211 also functions as abnormality detector for detecting

abnormalities caused during the image taking and/or inappropriate images from information obtained from the camera-movement detection sensor 320, the WB sensor 21, the luminescence-control sensor 305, a distance sensor (not shown) and/or a sensor for detecting a battery-run-out. The aforementioned abnormality includes camera-movements, obstacle-crossing, sudden changes of incidence light and a battery-run-out, which are inappropriate conditions by which inappropriate images may be obtained by executing multiplex image processing. The aforementioned inappropriate images include an image which is inappropriate for the multiplex image processing. When abnormality is detected, the general control portion 211 also functions as control means for suspending the processing in the multiplex image taking mode and indicating that the multiplex image taking was unsuccessful.

Furthermore, the general control portion 211 has the image number counter which counts the number of images for a multiplex image taking.

As shown in Fig. 5, the general control portion 211 has a luminance detector 211a for setting an exposure control value (i.e., a shutter speed) and a shutter speed setting unit 211b. In the image taking preparation mode, the luminance detector 211a detects the brightness of the photographic object based on the image taken by the CCD 303 every 1/30 seconds. In other words, the luminance detector 211a determines the brightness of the photographic object from the image data updated and stored in the image memory 209.

The luminance detector 211a divides the memory area of the

image memory 209 into nine blocks, and calculates the luminance of each block based on the pixel data representing the G (green) component.

5 The shutter speed setting unit 211b has a shutter speed table, and determines the shutter speed (that is, the integral time of the CCD 303) based on the brightness of the photographic object detected by the luminance detector 211a.

10 The shutter speed is initialized to 1/128 seconds at the beginning of the activation of the digital camera 1. During the image taking preparation mode, the shutter speed setting unit 211b varies the shutter speed from the initial value to a higher speed or a lower speed stepwise, based on the brightness detected by the luminance detector 211a.

15 The general control portion 211 has a scene type detector 211c which determines the current image taking condition among from four types of scenes, "low-luminance scene," "middle-luminance normal scene," "middle-luminance backlight scene," and "high-luminance scene," in order to set the optimum shutter speed, and to appropriately perform the  $\gamma$  correction and filtering correction (which will be described in more detail below). In the "low-luminance scene," auxiliary light (i.e., flash light) is generally required when taking an image, for example, in indoor or in the night fall. In the "middle-luminance normal scene," the brightness of available  
20 light (either natural light or artificial light) is appropriate, and a picture is taken out of the light without auxiliary light. In the "middle-luminance backlight scene," the brightness is

appropriate, however, a picture is taken against light. In this case, flash light is desired. The "high-luminance scene" is on the very bright condition, such as a scene on the beach or a ski slope in a clear day. The determination result of the scene type detector 211c is stored in the memory 211d.

The general control portion 211 also has an image type detector 211e which determines whether the taken image is an ordinary photographic image (referred to as a "natural image"), such as a landscape or a portrait, or a text image, such as characters or charts written on a white board (referred to as a "text image" which resembles a binary image).

The image type detector 211e creates a histogram of the luminance of each pixel location based on the pixel data of the image stored in the image memory 209, and then, determines whether the photographed image is a natural image or a text image based on the histogram.

In general, the histogram of the luminance of the natural image has a gently curved luminance distribution with a single peak value, while the text image has a double-peak luminance distribution with two conspicuous areas in the black and white portions of the image, respectively. Therefore, the image type detector 211e distinguishes whether a picked-up image is natural image or character image by distinguishing whether the histogram of the luminosity data of a picked-up image is 1-peak distribution, or it is 2-peak distribution. And this judgment result is also stored in the memory 211d.

In order to record the taken image, the general control



portion 211 has a filter 211f for filtering the image data, a recording image generator 211g for generating a thumbnail image and a compressed image and a reproduction image generator 211h for reproducing the image recorded in the memory card 8 on the LCD 10.

The filter 211f consists of five digital filters to correct for the high frequency component of the image data at each compression rate 1/8 or 1/20, thereby correcting the edge in the image to be recorded. Five filters includes a digital filter for performing a standard edge correction, two digital filters for enhancing the edge of the image in comparison with the standard edge correction, and two digital filters for weakening the edge of the image in comparison with edge correction.

The recording image generator 211g reads the pixel data out of the image memory 209, and generates a thumbnail image and a compressed image which are to be recorded in the memory card 8. To be more precise, the recording image generator 211g scans the image memory 209 in the raster direction, and reads out every 8 pixels in both the horizontal and vertical directions to create a thumbnail image. The read pixel data (or the thumbnail images) are successively transferred to and recorded in the memory card 8.

The recording image generator 211g also reads out the entire pixel data from the image memory 209, and applies a prescribed data compression based on a JPEG method, such as two-dimensional DCT conversion or Huffman coding, to create a compressed image data. The compressed image data is recorded in the primary image

area of the memory card 8.

As shown in Fig. 6, the memory card 8 can store forty frames of images taken by the digital camera 1 at a 1/20 compression rate. Each of the frames 81-85 has tag information, high-resolution image data (640 × 480 pixels) compressed by a JPEG method, and thumbnail image data (80 × 60 pixels). Each frame may be an image file of EXIF type.

When in the image taking mode the shutter button 9 is depressed to start image taking, the general control portion 211 creates a thumbnail image created from the image taken in the image memory 209 after the start of the image taking operation, and the compressed image created by a JPEG method when the compression mode is selected by manipulating the compression rate setting slide switch 12. A tag information (such as the frame number, exposure value, shutter speed, compression rate K, photographing date and time, flash ON/OFF data, scene information, image type, judged result of the image, etc) stored in the memory card 8, the compressed image and the thumbnail image are stored in the memory card 8.

When in the multiplex image taking mode the shutter button 9 is depressed to start taking images, after obtaining the N pieces of images into the image memory 209, the general control portion 211 creates a thumbnail image created from the image taken in the image memory 209 and the compressed image created by a JPEG method when the compression mode is selected by manipulating the compression rate setting slide switch 12. Operation for storing tag information (such as the frame number,

exposure value, shutter speed, compression rate K, photographing date, flash ON/OFF data, scene information, judged result of the image, etc) stored in the memory card 8, the compressed image and the thumbnail image into the memory card 8 is repeated N times.

5       The function of each portion shown in the aforementioned embodiment may be performed by an independent circuit, a software or a combination thereof. Furthermore, the function may be performed by mutual action of a plurality of circuits.

By the way, multiplex image processing, i.e., processing for composing a plurality of images of the same photographic object sequentially taken into a single image, is performed for the various objects as will be explained below.

(1) Method for obtaining a super-resolution image

10       A plurality of images of the same photographic object are taken from slightly shifted image taking positions. Then, a single image with increased resolution is obtained from the plurality of images with different sampling phases.

(2) Depth control

15       In the depth control, a depth of field is changed without actually varying an aperture stop size. When a photographic object has a distance distribution, e.g., a foreground and a background, the foreground image and the background image are taken by focusing the foreground and the background, respectively. An image (all focused image) which is focused on  
20 both the foreground and the background or an image which emphasizes the unfocussed background is obtained from the  
25 aforementioned two images.

### (3) Gradation control

In the gradation control, two images taken with different exposure levels are composed to extend the apparent dynamic range. The gradation characteristic ( $\gamma$  curve) of the composite image is operated to make the optimal gradation reproducibility for the scene.

### (4) Image stabilization

In cases where a proper shutter speed is  $S$  seconds and image blurring caused by a camera-movement is likely to occur on that condition,  $N$  pieces of images are taken ( $T \times N=S$ ) in a shutter speed of  $T$  seconds which does not cause image blurring caused by a camera-movement, then these images are composed into an image with no influence of a camera-movement.

Next, in the digital camera 1, operation for performing a standard image taking (single image taking mode) will be first explained briefly with reference to the flow chart of Fig. 8. In the following explanation and the drawing, a step is abbreviated as "S".

In S101, when the shutter button 9 is depressed by an user, exposure will start in S102. In S103, after the completion of the predetermined exposure, image processing, such as white balance compensation, gamma compensation, noise removal, color compensation and color emphasis, is performed in S104,. In the meantime, after the predetermined exposure is completed and the images are stored in a buffer memory temporarily, the aforementioned image processing may be performed. In S105, image information is stored in the memory card 8 after the completion

of the image processing.

Next, in a multiplex image-taking mode, operation for performing abnormality detection during the image taking will be explained with reference to the flow chart of Fig. 9.

5 In S201, a mode setting is performed according to the mode setting operation by an user. Here, when set to the multiplex image taking mode, it becomes possible to set the number of images to be taken.

10 In S202, when the shutter button 9 is depressed by the operation of an user, the indicator 432 in the viewfinder (LCD display portion) will be turned on to indicate that images are being taken in the multiplex image taking mode in S203. Thereby, the user can recognize that the current mode is a multiplex image taking mode unlike a normal single image taking mode, a long time exposure mode or a motion picture taking mode.

15 In S204, when exposure starts, the general control portion 211 will judge whether or not the multiplex image taking was unsuccessful during the exposure in S205. If there is no abnormality (NO in S205), the exposure will be completed in S206 and the images taken are temporarily stored in the image memory 209 in S207.

20 Thereafter, in S208, it is judged whether or not the number of images taken has reached the predetermined number required by the multiplex image taking mode. If the number has not yet reached the predetermined number (NO in S208), the routine returns to S204 to repeat the predetermined operation. If the number has reached the predetermined number (YES in S208), in

S209, the indicator 432 indicates that the multiplex image taking was completed, that is, the indicator is turned off. Subsequently, in S210, the white balance of the image stored in the image memory 209, etc. is processed, and in S211, all of the image data are stored in the memory card 8.

In S205, when abnormality (failure) during the multiplex image taking is detected by the general control portion 211 (YES in S205), the general control portion 211 suspends the processing of the normal multiplex image taking mode, turns off the indicator 432 indicating that the multiplex images are being taken in S212, and indicates by the indicator 431 that the multiplex image taking was unsuccessful in S213.

In S214, a dialog for making a user choose whether all of the images taken are to be left or whether some of the images taken are to be left is displayed on the LCD 10. When an user selects images, the routine proceeds to S210 to perform image processing, such as white balance compensation of the selected images. Subsequently, in S211, the selected images are stored in the memory card 8. Of course, it is also effective to automatically store all of the images taken or some of the images into the memory card 8, without the user's selection.

At the time of this image selection, as shown in Fig. 10, thumbnail images SV are displayed on the LCD 10. Since an user can move the arrow P on the screen to an arbitrary position by operating the UP key 6 and/or the DOWN key 7, it is possible for the user to switch a selection/non-selection of the image by depressing the shutter button 9 with the arrow P pointed on a

desired image SV. In this embodiment, a selection of the thumbnail image SV causes a thicker border Sa thereof for an easy recognition of the selection. Alternatively, it is also possible to adopt any method in which a color of the whole image SV changes, etc.

Furthermore, when it comes to a power supply failure, a user can recognize the failure of the multiplex image taking. Thus, the user can replace a battery with new one to send an instruction of the multiplex image taking again, or can dare to save the image as a single image.

By the way, in this embodiment, when a user starts to take images while looking at the viewfinder in a multiplex image taking mode, the indicator 432 in the viewfinder is automatically turned on. For this reason, even if an user misunderstands that the current mode is set to a single image taking mode, the user can recognize the current mode through the indicator, which enables to obtain multiplex images successfully.

In addition to the above, it is also possible to indicate that a single image taking mode is selected. For example, as shown in Fig. 11, the viewfinder may be provided with an indicator 52 selectively indicating a character of "single" or "multiplex," wherein the "single" is displayed when an image is being taken in the single image taking mode, and the "multiplex" is displayed when images are being taken in the multiplex image taking mode. This enables an easy understanding of the meaning of the display.

Moreover, the indication showing the multiplex image taking

mode may be any indication so long as it indicates that images are being taken in the mode. For example, if a mark which calls a user's attention not to move the digital camera 1 when images are being taken is indicated, the user can take images in a state that no camera-movement occurs taking into account of a multiplex image taking mode. This enables to obtain a plurality of images which do not cause a poor image.

Furthermore, if it is indicated by characters instead of a caution mark, even if a user is not familiar with the operation of the digital camera 1, the user can easily recognize that the current mode is a multiplex image taking mode, resulting in a user-friendly camera. Of course, a mark may be used to indicate that an image is being taken in a single image taking mode, and letters may be used to indicate that images are being taken in the multiplex image taking mode.

Furthermore, if it has a motion picture mode, it may be indicated in the viewfinder (LCD 10) such that a user can recognize that images are being taken in a multiplex image taking mode, and it may be indicated that movie images are being taken in the motion picture mode by an indication method different from the indication method for indicating the multiplex image taking without an indicator for a single image taking mode. Concretely, as shown in Fig. 12, it may be indicated by, for example, a star-shaped mark (or character) at the display portion 62 that multiple images are being taken, and by, for example, a round mark (or character) at the display portion 63 that movie images are being taken.



Moreover, at the outer surface of the digital camera 1, a display portion 433 consisting of a lamp, such as an LED, which indicates the multiplex image taking mode may be provided in the front surface of the image pick-up portion 3 like a tally lamp as shown in Fig. 13. This notifies that a photographic object person can also recognize that images are being taken in a multiplex image taking mode, which prevents the photographic object person from moving unwillingly.

Furthermore, in cases where the aforementioned display portion 433 is provided at the image pick-up portion 3, if the image pick-up portion 3 is capable of being separated from the camera main body 2, the photographic object person may not overlook that the image of the photographic object person is being taken in the multiplex image taking mode even in the state where the image pick-up portion 3 is separated from the camera main body 2. And if it is constituted such that the LED, etc. blinks, the function of calling attention to a photographic object person will be further enhanced.

Furthermore, it may also be displayed on an external monitor that multiplex images are being taken. In the event that the viewfinder or LCD 10 is not provided in the digital camera 1 or that the digital camera 1 is disposed at a place where it is difficult for an user to easily confirm the digital camera 1, it is possible to recognize that multiplex images are being taken through an external monitor's display.

Next, in the multiplex image taking mode, the operation for detecting abnormality of the images taken will be explained with

reference to the flow chart of Fig. 14.

First, in S301, a multiplex image taking mode is set. Then, in S302, when the shutter button 9 is depressed by the operation of an user, in S303, it will be displayed on the indicator 432 that multiplex images are being taken. Thereafter, exposure starts in S304. After the exposure is completed in S305, the image memory 209 stores the taken image in S306.

Subsequently, in S307, it is judged whether or not the number of images taken has reached the predetermined number required by the multiplex image taking mode. If the number has not reached the predetermined number (NO in S307), the routine returns to S304 to repeat the predetermined operation. If the number has reached the predetermined number (YES in S307), in S308, the indicator 432 in the viewfinder is turned off for indicating that the multiplex image taking was completed.

Thereafter, in S309, the general control portion 211 judges whether or not the multiplex image taking was unsuccessful from the contents of image data, the number of image data, or the like. If there is no abnormality (NO in S309), in S310, image processing, such as white balance compensation, will be subjected to all the images temporarily stored in the image memory 209. Then, in S311, the image information on all of the images will be stored in the memory card 8.

In the event that the number of images required by a user has not been taken, or in the event that abnormality occurs, e.g., blur of an image caused by camera-movement is conspicuous although the number of images is enough, or blackish portions or

whitish portions in which shadow gradation or highlight gradation is lost have occurred, the general control portion 211 detects the abnormality (YES in S309). The general control portion 211 suspends the processing in the normal multiplex image taking mode. Then, in S312, it is indicated by the indicator 431 in the viewfinder that the multiplex image taking was unsuccessful.

Then, in S313, a dialog for making a user choose whether all of the images taken are to be left or whether some of the images taken are to be left is displayed on the LCD 10. When an user selects images, the routine proceeds to S310 to perform image processing, such as white balance compensation of the selected images. Subsequently, in S311, the selected images are stored in the memory card 8. Of course, it is also effective to automatically store all of the images taken or some of the images into the memory card 8, without the user's selection.

In cases where the multiplex images include an inappropriate image with the aforesaid blurs, blackish portions or whitish portions although the number of images for the multiplex image processing is enough, the appearance of the final composite image becomes poor because of the influence of the poor image. Thus, the multiplex images are not suitably subjected to the multiplex image processing. That is, it becomes possible to delete the poor image by the user because of the temporary suspension of the multiplex image taking.

By the way, even if the images taken in the multiplex image taking mode are unsuitable for multiplex image processing, in the event that a user missed a photo opportunity, it is sometimes

difficult to take the image of the same scene again. Even in such a situation, the image can be stored in the memory card 8 as a single image by the operation of the user, not treating the images to be subjected to multiplex image processing.

5 In this case, it is possible to automatically select some of the images to be stored into the digital camera 1 among the plurality of images taken for the multiplex image processing.

In the meantime, in the event that an user selects some desired images among the images taken in the multiplex image taking mode and stores them in the memory card 8, the capacity of the memory card 8 can be saved, resulting in a larger number of images stored therein.

As mentioned above, although an embodiment according to the present invention was explained, the present invention is not limited to the above embodiment. In the aforementioned embodiment, when abnormality disturbing the multiplex image processing is detected, the processing in the multiplex image taking mode is suspended, and it is indicated on the display or indicator that there is abnormality. However, it may be performed one of them, a suspension of the image taking mode or a display of abnormality. Alternatively, when abnormality is detected, it may be possible to instruct a re-trial of the multiplex image taking.

In the aforementioned embodiment, although a detection of abnormality during the image taking and a detection of abnormality based on the image data after having taken images are separately performed, both the detections may be performed in the

same multiplex image taking mode.

In the aforementioned embodiment, the indicator 431 for indicating abnormality and the indicators 432, 52 and 62 for indicating the multiplex image taking and the indicator 63 are provided on the LCD 10 as a viewfinder. However, in cases where the digital camera 1 is provided with an optical or electronic viewfinder, the aforementioned indicator 431, 432 and the like, may be provided in such a viewfinder. Moreover, the indicator may consist of, for example, light emitting diodes instead of liquid crystal display. In the meantime, the indicator may be provided at a portion other than the viewfinder portion, for example, a portion on the external surface of the digital camera 1. In this case, the indicator can be provided even if the camera has no viewfinder or does not perform electric processing within a viewfinder. However, it is preferable to provide the indicator in the viewfinder through which a user always looks the image of the photographic object during the image taking because the indicator can be enhanced in visibility.

In the aforementioned embodiment, although an external apparatus performs the multiplex image processing and a digital camera performs from image taking to record of images, a digital camera may have a multiplex image processing function.

The terms and descriptions in this specification are used only for explanatory purposes and the present invention is not limited to these terms and descriptions. It should be appreciated that there are many modifications and substitutions without departing from the spirit and the scope of the present

invention which is defined by the appended claims.